1. For the following integrals, sketch the region of integration, and then reverse the order of integration.

\[
\int_0^1 \int_{1-x}^{1-x^2} f(x, y) \, dy \, dx \quad \int_0^{\ln 3} \int_{e^y}^{3} g(x, y) \, dx \, dy
\]

2. Compute \( \iint_D 2x + y \, dA \), where \( D \) is the region in the plane bounded by the line \( y = 3 - 2x \) and the hyperbola \( xy = 1 \).

3. Compute \( \iint_D x^2 y \, dA \), where \( D \) is the region in the first quadrant inside the circle \( x^2 + y^2 = 4 \) and outside the circle \( x^2 + y^2 = x \).

4. Compute \( \iint_D 4 + x^2 \, dA \), where \( D \) is the region in the plane bounded by the parabolas \( y = x^2 + 1 \) and \( y = 3 - x^2 \).

5. Compute \( \iint_D x^3 + xy^2 \, dA \), where \( D \) is the region in the first quadrant bounded by the circle \( x^2 + y^2 = 1 \) and the lines \( y = x \) and \( y = \sqrt{3}x \).

6. Compute \( \iint_D x^2 + y \, dA \), where \( D \) is the region in the plane bounded above by the curves \( y = x^2 \) and \( y = 6 - x \) and below by the \( x \)-axis.

7. Let \( D \) be the region in the plane that lies inside the circle \( x^2 + y^2 = 6y \) but outside the circle \( x^2 + y^2 = 9 \). Compute the area of \( D \).

8. Compute \( \int_0^1 \int_{x^{1/3}}^1 \cos(\pi y^4/2) \, dy \, dx \).

9. Find the volume of the solid that lies between the paraboloids \( z = x^2 + y^2 \) and \( z = 36 - 3x^2 - 3y^2 \).

10. Find the volume of the solid bounded by the surface \( z = e^x \) and the planes \( x = y, \, x = 1, \, y = 0, \) and \( z = 0 \).

11. Let \( E \) be the tetrahedron with vertices \((0, 0, 0), (1, 0, 0), (0, 2, 0), \) and \((0, 0, 4)\), and with constant density 1. Find the mass and center of mass of \( E \).

12. Let \( E \) be the solid region below the plane \( z = 10 - x \), above the plane \( z = x + y \), and between the surfaces \( x = y^2 \) and \( y = x - 2 \). Compute \( \iiint_E y \, dV \).

13. Let \( E \) be the solid region between the parabolic cylinder \( y = 2z^2 \) and the plane \( y = -2z \), bounded in front by the plane \( x = 4 \) and in back by the plane \( x + z = y \). Compute \( \iiint_E z^2 \, dV \).
14. Let \( E \) be the solid lying inside the sphere \( x^2 + y^2 + z^2 = 4 \) and below the cone \( z = \sqrt{x^2 + y^2} \). Compute \( \iiint_E z^2 \, dV \).

15. Let \( E \) be the portion of the solid in the first octant bounded by the \( xz \)-plane, the \( yz \)-plane, the plane \( z = 4 \), and the paraboloid \( z = x^2 + y^2 \). Compute \( \iiint_E x \, dV \).

16. Let \( E \) be the solid region between the spheres \( x^2 + y^2 + z^2 = 1 \) and \( x^2 + y^2 + z^2 = 2 \), and inside the (upper half of the double) cone \( z = \sqrt{x^2 + y^2} \). The density of \( E \) at \( (x, y, z) \) is \( z^2 \). Compute the mass of \( E \).

17. Let \( a > 0 \). Find the volume of the solid inside both the sphere \( x^2 + y^2 + z^2 = a^2 \) and the cylinder \( x^2 + y^2 = ax \), and in the first octant.

18. Let \( E \) be the solid bounded by the surfaces \( y = 1 - x^2 \), \( y = 0 \), \( z = y \), and \( z = 1 \). Suppose that the density of the solid is \( \rho(x, y, z) = 2(1 + x^4) \). Compute the mass of \( E \).

19. Compute \( \int_{-3}^{3} \int_{0}^{\sqrt{9-y^2}} \int_{-\sqrt{9-x^2-y^2}}^{\sqrt{9-x^2-y^2}} y^2 \sqrt{x^2 + y^2 + z^2} \, dz \, dx \, dy \).

20. Let \( E \) be the solid between the spheres \( x^2 + y^2 + z^2 = 1 \) and \( x^2 + y^2 + z^2 = 9 \), below the cone \( z = \sqrt{x^2 + y^2} \), and above the cone \( z = -\sqrt{3x^2 + 3y^2} \). Compute \( \iiint_E x^2 \, dV \).

21. Let \( E \) be the solid between the paraboloid \( z = x^2 + y^2 \) and the cone \( z = 2\sqrt{x^2 + y^2} \) in the first octant. Compute \( \iiint_E y^2 \, z \, dV \).